Table 1
BA-NJ / Hatfield Comparison

	Actual	Model	Model/Actual
Investment:			
Network	$7,183	$3,491	48.60%
Switching	$1,527	$563	36.87%
Support	$1,025	$304	29.63%
Total	$8,208	$3,795	46.23%
Expenses:			
Network	$418	$174	41.67%
Switching	$98	$15	15.45%
Support	$384	$146	38.07%
Corporate	$321	$99	30.97%
Total	$1,123	$420	37.38%

Source: Actual data - 1995 ARMIS data. Model data - Hatfield Model Release 4.0 outputs.

Q. PLEASE DESCRIBE YOUR TABLE.

A. The top part of the table compares BA-NJ's actual capital investment to the purportedly "forward-looking" results of the Hatfield Model. For example, the table shows that the Hatfield Model produces ***only 48.6 percent*** of the investment in network components that BA-NJ currently has on its books. For end-office switching, the model performs even worse, producing ***only* 36.87 *percent*** of current investment. Similarly, the model produces ***only 29.63 percent*** of the support investment (vehicles, office equipment, and the like) that BA-NJ is currently using. Turning to expenses, the model produces ***only 37.38 percent*** of the expenses that BA-NJ currently incurs. The comparison is especially stark for end-office switching, where the model estimates that BA-NJ can maintain its switches for ***only 15.45 percent*** of the cost it currently incurs. While one would expect to see prices of network components and associated expenses to decline in the future, the reductions forecasted by the Hatfield Model are too extreme to be real and should not be presented as the costs that an "efficient" carrier would be likely to incur.

Q. WHY ARE CURRENT COSTS A USEFUL BENCHMARK FOR EVALUATING THE RESULTS OF A FORWARD-LOOKING COST MODEL?

A. Contrary to Dr. Mercer's claim that current costs provide no information for establishing forward-looking costs, for many types of costs, current levels can serve as an excellent starting point for forecasts of forward-looking costs. Indeed, the Hatfield Model proponents have consistently argued that its loop costs are based on technology that has been in place for years and that current engineering practices are followed. Thus, even Hatfield implicitly admits that observation of actual costs (and the actual loop facilities themselves) is more reliable than cost estimates based on a made-up "blue print" that has never formed the basis for a functioning network.[10]

Q. BUT IS IT NOT POSSIBLE THAT FORWARD-LOOKING COSTS WILL DIFFER FROM CURRENT COSTS?

A. Yes. Dr. Mercer [Mercer at 52] claims that such a difference makes current costs totally useless as an indicator of forward-looking costs. However, while forward-looking costs and current costs will not necessarily match dollar-for-dollar, the obvious and critical question is whether a model that produces forward-looking costs that are only one-half (or even less) of current costs is credible. The answer to this question is an overwhelming "No". While technological change and competition will undoubtedly make local exchange carriers more efficient, the idea that BA-NJ can produce everything it currently does at less than half its cost is ludicrous.

Q. DO YOU HAVE ANY OTHER COMMENTS ON HOW THE HATFIELD MODEL SUBSTITUTES THE JUDGMENT OF ITS EXPERTS FOR THE JUDGMENT OF BA-NJ'S MANAGEMENT WHICH HAS SUBSTANTIAL EXPERIENCE IN PROVIDING LOCAL SERVICE?

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[10] Economists routinely study the actual cost characteristics of a firm or industry instead of relying on hypothetical models. For example, Professor David Kaserman (also an AT&T witness), testifying on behalf of AT&T in GTE arbitrations, cited an econometric study of actual telephone company historical costs in support of his assertion that local exchange service is not a natural monopoly. Richard Shin and John S. Ying, "Unnatural Monopolies in Local Telephone," *Rand Journal of Economics*, Vol. 23, 1992, pp. 171-183.

A. Yes. Dr. Mercer explicitly takes a position that amounts to a belief that the judgment of the experts responsible for the Hatfield Model should overrule the business decisions of BA-NJ's management. For example, Dr. Mercer believes that the judgment of the Hatfield Model's engineering advisors on structure sharing should override both historical evidence as well as the Company's judgment regarding feasible sharing levels in the future.

The difficulty of basing costs on an abstract representation of a network is exacerbated by the fact that engineering decisions involve a considerable degree of judgment, with different engineers making different decisions in similar situations. In effect, the Hatfield Model proponents would substitute the "one-size-fits-all" judgment of a small handful of engineers for the collective judgment of BA-NJ engineers and management who have substantial experience in providing efficient and reliable service.

II. SPECIFIC CRITICISMS OF THE HATFIELD COST MODEL

A. The Hatfield Model Does Not Describe the Manner in which a Firm Evolves to Serve Customers nor the Manner in which Firms will Operate Under Competition

Q. HOW DOES THE HATFIELD MODEL FAIL TO REPRESENT THE TECHNOLOGICAL AND ECONOMIC ENVIRONMENT IN WHICH BA-NJ OPERATES TODAY AND WILL OPERATE IN THE FUTURE IN OFFERING BASIC SERVICE?

A. In a nutshell, its assumption that the entire network (utilizing existing wire centers) is instantly constructed and is perfectly sized to serve current demand -- that underlies the Hatfield Model's cost estimates is grossly inconsistent with how real efficient firms incur costs. The problem with this approach is the implicit assumption that the Incumbent Local Exchange Carrier ("ILEC") will lose one hundred percent of its demand for telephone services on day one. In effect, the Hatfield Model assumes an ILEC would hand over its entire business to each newcomer, which in turn would instantly size its plant to perfectly accommodate this demand, taking advantage of all the economies that come with serving the demand with perfectly sized facilities obtained at the maximum volume discounts.

This assumption is counterfactual; real firms grow to meet demand as it materializes. As such, firms in the real world add capacity taking into account the trade-off between the lower per unit costs of bigger modules (*e.g.*, larger cable sizes) and the costs of carrying the unused capacity that deploying larger modules would entail. Typically, networks *do not and should not* have, as the Hatfield Model assumes, a single cable (or even several cables) installed at a single point in time. One large cable would be significantly less expensive to procure and install today than it would cost to procure and install several smaller cables. However, a carrier that minimizes its costs over a long period of time typically will have installed several smaller cables to accommodate growing and uncertain demand.

Indeed, the recent testimony of an AT&T and MCI witness, Mr. Stephen Siwek, in a proceeding in Pennsylvania is in substantial agreement on this point. When questioned about whether MCI or AT&T used the Hatfield Model to plan their own local service networks, Mr. Siwek, sponsoring an earlier version of the Hatfield Model, responded that to his knowledge they did not, going on to explain that "the suggestion implicit in your question that this would be a useful thing to do strikes me as a bit, frankly, ridiculous because MCI would have to assume that it instantly can serve all of the demand in the state of Pennsylvania. And that assumption is simply not realistic." [11]

Q. DR. MERCER (P. 61-62) ARGUES THAT SPARE CAPACITY THAT ACCOMMODATES GROWTH IS NOT A CURRENT COST. THEREFORE, FILL FACTORS SHOULD NOT REFLECT SUCH SPARE CAPACITY? IS HE CORRECT?

[11] Pennsylvania Public Utility Commission Dockets A-310203F000 2, A-310213F0002, A-310236F0002, and A-310258F0002, February 26, 1997, Tr. 1364.

A. No. To the extent that efficient operation requires spare capacity to accommodate demand growth or demand uncertainty, the associated costs are current costs that should be captured in the fill factors, *i.e.*, the spare capacity is a permanent cost of doing business.

Q. DOES THE HATFIELD MODEL CONFINE ITS SCORCHED NODE ASSUMPTION ONLY TO BA-NJ?

A. No. As strange as it seems, the model assumes that *all* utilities capable of sharing structures operate in the scorched node mode. In other words, the Hatfield Model assumes that electric utilities and cable companies that share existing poles would immediately be moved to a brand new network sized for 100% of the existing telephone network regardless of their serving territory. Further examination of the model's workings reveals that the whole service territory -- buildings and all -- is being "scorched." In its place, the model places hypothetical, uniformly designed buildings throughout New Jersey. Of course, this bears very little resemblance to what you see when you look out the window.

Q. DOES THE HATFIELD MODEL PROPERLY RECOGNIZE HOW COMPANIES WILL OPERATE IN A COMPETITIVE TELECOMMUNICATIONS MARKETPLACE?

A. The Hatfield Model fails to recognize that both technological progress and increased uncertainty under competition will have important consequences for the rate at which network facilities (particularly, loops) are utilized. In particular, the model assumes fill factors (*i.e.*, utilization rates) that are too high. Although during the Interconnection Phase of this proceeding the Board chose fill factors for distribution plant that are consistent with efficient amounts of spare capacity, Dr. Mercer (pp. 63-65) persists in using the unrealistically high default values in the Hatfield model.

Q. WHAT REASONS DOES HE GIVE FOR HIS REJECTION OF THE BOARD'S FILL FACTORS?

A. Two of his reasons incorrectly dispute the fact that the Board has prescribed efficient levels of spare capacity. In effect, he is simply advocating that the judgment of the Hatfield model proponents be substituted for judgment of the Board based upon its consideration of expert testimony filed during the interconnection phase of this proceeding. He also contends that the model produces fill factors that are lower than the input values. Although the assertion appears to be factually correct, even the realized fill factors are much higher than the Board's values.

Q. ARE THERE OTHER PROBLEMS WITH THE MANNER IN WHICH THE HATFIELD MODEL ESTIMATES INVESTMENT-RELATED EXPENSES?

A. Yes. The manner in which the Hatfield Model calculates Return, Depreciation, and Income Tax (Total Return) is suspect. Once the artificially low "forward-looking" network investment costs are calculated, the Model converts these investments into annual amounts over the economic life of the investment.

The model makes two errors in this calculation. First, it bases the return and tax gross-up calculation on the net plant in the middle of the year, rather than the beginning of the year. For example, to calculate return and taxes for the first year, the model uses net investment after six month's worth of depreciation, rather than the (correct) initial investment. In addition, the Model uses a pre-tax, rather than an after-tax, discount rate in calculating present values and annualized amounts. These errors are repeated in the calculation process of capital costs in every year of relevant depreciable life of a plant, resulting in a repeated and systematic understatement of cost.

B. Inaccurate Assumptions and Input Values in the Hatfield Model

Q. PLEASE DISCUSS YOUR SECOND MAJOR CRITICISM, NAMELY, THE INACCURACIES IN ENGINEERING PROCESSES, OMITTED COSTS, AND INCORRECT INPUT VALUES.

A. Probably the most fundamental problem with the Hatfield Model is its inaccurate depiction of distribution facilities. Given the fact that distribution accounts for 37 percent of the Hatfield Model's basic universal service costs and 52 percent of loop costs for New Jersey, errors in modeling distribution can seriously affect the "cost" results.

The essence of the problem is that Census Block Groups ("CBGs"), which the Hatfield Model uses as a critical input to estimate required distribution facilities, poorly approximates outside plant local serving areas. In fact, CBGs bear no relationship to outside plant local serving areas which are established based upon engineering considerations and actual customer locations, rather that geographical areas established for the purpose of census reporting. Indeed, at a cost proxy model workshop earlier this year, an outside plant advisor to the Hatfield Model described how CBGs, which range in size from 0 to 7,287 households in New Jersey, are intended to approximate outside plant local serving areas-- areas of 200 to 600 households.[12] The fact that CBGs can contain many more households than actual outside plant local serving areas also suggests that CBGs can cover a much larger area than actual serving areas.[13] In fact, 37 percent of the CBGs assigned to BA-NJ, accounting for 48 percent of all lines, fall *outside* the range discussed by the Hatfield Model's "outside plant advisor". That is, CBGs appear to fall far short of an accurate depiction of outside plant local serving areas in New Jersey and for this reason, it is not surprising that its loop costs are unreliable. Consequently, because the representation of distribution facilities is based on an inaccurate approximation of local serving areas, it is unlikely that the model could ever produce accurate and reliable forward looking cost estimates.

Furthermore, the Hatfield Model developers themselves have acknowledged that CBGs are too imprecise as a representation of local serving area and wire center geographies, and have decided to move away from the use of CBGs in the next version of the Hatfield Model. In fact, Dr. Mercer has stated that:

[12] Workshop before the Washington Utilities and Transportation Commission, Dockets UT-960369, UT-960370, and UT-960371, February 14, 1997, pp. 158-159 ("Washington Workshop").

[13] Arguably, the Hatfield Model's local serving area is the quadrants within the CBGs, rather than the entire CBGs. Even with this definition of outside plant local serving area, the Hatfield Model is well outside of the range indicated by their outside plant advisor. Now, 90 percent of the CBGs, accounting for 77 percent of lines are outside the 200 to 600 household range.

> CBGs are large. They may be served by several wire centers; and going to a [Census Block] level or below level of disaggregation really much more precisely pins down the wire centers.[14]

Q. HAS THE REPRESENTATION OF DISTRIBUTION PLANT BEEN GREATLY CHANGED SINCE RELEASE 2.2?

A. Yes. Earlier versions of the Hatfield Model relied extensively on the distribution components of the Benchmark Cost Model ("BCM"). That model was originally developed to identify high cost areas, in contrast to establishing actual prices for basic service or network components throughout a serving territory. Extensive review of these earlier versions uncovered substantial failings in that approach. For example, Shifman and Choura (of the Maine and Michigan Commission staffs, respectively) noted that the earlier models placed distribution cables that are considerably larger than those actually employed by incumbent telephone companies.[15] As a result, these earlier versions greatly underestimated the number of distribution routes and the amount of support structures necessary in outside plant local serving areas.

Q. HAVE THE NEWER RELEASES ADDRESSED THESE CONCERNS?

A. While the documentation provided with the latest versions of the model, Releases 3.1 and 4.0, suggest that is the case, the results generated by the model cast substantial doubt on that representation. In particular, the model attempts to model specific distribution routes, with larger cables at the serving area interface that taper to smaller cables near customer locations. In contrast, the earlier versions abstractly placed a few large non-tapering cables of equal length. Indeed, while the average distribution loop length is similar to that of Hatfield 2.2.2,

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[14] Pennsylvania Public Utility Commission (Docket No. I-00940035) *Formal Investigation to Examine and Establish updated Universal Service Principles and Policies for Telecommunications Services in the Commonwealth*, October 8, 1997, Page 2405.

[15] J. Shifman and R. Choura, "Universal Service Existing Proxy Models: What can they be used for?" at 23, submitted to the Biennial Regulatory Information Conference at NRRI, September 1996. These authors conclude that the outputs of the Hatfield Model are not valid, noting for example: "its results . . . deviate so greatly from actual costs that the model can't be taken seriously at this time without detrimental effects on the current providers of telephone services." (at 15) The authors also conclude that: "models (including Hatfield) are so seriously flawed that we do not believe any amount of work can remedy their serious deficiencies" (at 22) and "the results of the Hatfield do not even pass a 'straight face test'." (at 24)

there are many more cables of considerably smaller sizes. In addition, route lengths have increased from 85 million route feet to 188 million route feet between Releases 2.2 and 4.0. Accordingly, one would expect structure costs to have increased as a result, because there are many more route miles.

While much less dramatic, there were changes between Releases 3.1 and 4.0 that would have been expected to increase loop costs. In particular, Dr. Mercer reports that certain cables in the distribution and feeder portions of the loop plant were missing in Version 3.1, but have been added to the current version. This change would seem to increase the total quantity of loop plant, thus increasing the cost of providing loop facilities. In fact, I estimate that the addition of the missing cable to Release 3.1 increases universal service costs by $0.69 per month in New Jersey.

Despite the more than doubling of route miles since Release 2.2, structure costs have curiously *decreased* by more than 13 percent in Release 3.1 and remained about the same in Release 4.0, as shown in Table 2, while total cable investment has decreased by about 1.6 percent. Of course, other inputs (placement costs, pole costs, pole spacing, sharing fractions with other utilities, and the fractions of structures by type, *e.g.*, aerial, etc.) have changed.

Table 2
Distribution Investments ($1,000)

	HCM 2.2	HCM 3.1	HCM 4.0
Aerial cable	$321,621	$219,919	$231,084
Poles	$46,095	$26,826	$28,428
Buried cable	$248,075	$413,379	$433,257
Buried placement-structures	$32,238	$138,666	$148,689
Underground Cable	$72,564	$11,206	$12,292
Underground placement/structures	$303,423	$58,699	$53,171
Drop Cable	$128,999	$101,714	$99,578
NIDs/terminal	$209,624	$335,549	$359,447
Total Cable	$642,260	$644,504	$676,633
Total Structures	$381,756	$224,191	$230,287
Drop/NID	$338,623	$437,263	$459,025
Total	**$1,362,640**	**$1,305,959**	**$1,365,945**
Lines (1,000s)	5,791	5,791	6,100
Route Feet (Millions)	85	173	188
Pair Feet (Millions)	31,369	28,416	41,586
Average Loop Length	2764	2435	3329
Average Cable Size	368	164	221
Cable Cost per Pair Foot	$0.0205	$0.0227	$0.0163
Structure Cost per Route Foot	**$4.49**	**$1.30**	**$1.22**

Q. DO YOU HAVE AN EXPLANATION FOR THESE PUZZLING FINDINGS?

A. Yes. The effect of the increase in route feet since Release 2.2 has been more than offset by a more than three-fold reduction in the average unit cost of support structures. In Release 2.2, support structures averaged about $4.50 per route foot. In Versions 3.1 and 4.0, the cost has decreased to $1.30 and $1.22 per foot, respectively. It is also significant that after all of the changes from Release 2.2 to Release 4.0, the total investment in distribution changed by less than 1% (*i.e.,* $1.365 billion to $1.362 billion).

Q. WHY HAS THE COST RESULT FOR STRUCTURES DECREASED SO SIGNIFICANTLY?

A. The newer versions of the Hatfield Model use less expensive support structure (*e.g.*, aerial instead of underground), particularly in high density areas. What is significant about this dramatic change in assumed structure costs is that in the various versions of the model, these inputs have been represented as the most reliable input values, based on the considerable engineering experience of the Hatfield Model's subject matter experts. It is inconceivable that forward-looking engineering practices, which presumably the subject matter experts were employing in their assumptions in prior versions of the model, have changed so that support structures are less than one-third as expensive as they were last year.

Q. HAVE ANY OF THE DEFAULT VALUES OF THE HATFIELD MODEL BEEN GREATLY CHANGED IN RELEASE 4.0?

A. Yes. The cost of copper cable has changed dramatically. For example, if one were to use the default value cable costs from Version 3.1 in Version 4.0 the costs of the loop would increase by 11.0% or $1.55. Similarly, Table 2 shows that while the average unit cost for cable is quite similar between Releases 2.2 and 3.1 (the default inputs are the same), the unit costs have fallen in Release 4.0 because of the reduction in the default costs for larger cables. Again, the same engineering advisors now believe that cable costs are significantly less than they believed they were a year ago.

Q. HAVE YOU IDENTIFIED ANY OTHER ERRORS?

A. Yes. While the Hatfield Model classifies the majority (60 or 85 percent) of cable in high density areas (over 5000 lines per square mile) as "aerial," it provides absolutely no support structure for aerial cable.[16] This is contrary to engineering practices identified by Hatfield Model engineering advisors. In particular, the Hatfield engineering advisor has said that in urban areas (1) when an aerial cable run is faced with crossing a street, it may come down the pole and cross the street underground through a conduit and that underground portion of the distribution is defined as aerial, and (2) poles for aerial cable are more expensive to place in

[16] According to the Hatfield Model Release 4.0 Model Description, page 29, this cable is assumed to be intrabuilding riser cable and "block cable" attached to buildings. However, Version 4.0 very clearly calculates riser cable in a separate calculation for only very specific CBGs. Examining the lengths of the cables calculated in the model clearly shows that these cables are meant to be laid horizontally, rather than vertically.

high density areas. The Hatfield Model thus understates structure investment by simply ignoring the fact that real firms such as BA-NJ require aerial structure support in high density areas.

Q. DR. MERCER CLAIMS [AT 20] THAT THE HATFIELD MODEL INCLUDES ALL COSTS THAT ARE NECESSARY TO PROVIDE LOCAL EXCHANGE SERVICE. IS THIS CORRECT?

A. No. I can provide specific examples of costs that are omitted from the model. For example, by using only integrated carrier systems, the Hatfield Model leaves out one-time and ongoing costs of providing unbundled voice-grade loops in quantities smaller than that provided over carrier systems.[17] Likewise, the model leaves out the cost of manholes for distribution plant.[18]

Similarly, the NID maintenance expense of $1 per line is designed to be applied to total *lines*.[19] In contrast, the Model actual applies this amount to an incorrect estimate of the number of *NIDs*. This error results in the NID expense being applied to 2.6 million fewer lines (over 40 percent) than intended for BA-NJ.

Q. DR. MERCER REPORTS THAT RELEASE 4.0 NOW INCLUDES FORMERLY EXCLUDED CABLES.[20] HAVE YOU EXAMINED THIS CHANGE TO THE MODEL?

A. Yes, and I have an observation on the process with which the change was made. Dr. Mercer's description could lead to the conclusion that (1) the Hatfield Model developers quickly and willingly made the necessary correction and that (2) this exclusion was identified only because

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[17] Staff Workshop to ask Clarifying Questions in Docket No. 16226 before the Public Utility Commission of Texas, September 27, 1996, pp. 77-101.

[18] Deposition Testimony of Dr. Robert Mercer, *Rulemaking on the Commission's Own Motion to Govern Open Access to Bottleneck Services and Establish a Framework for Network Architecture Development of Dominant Carrier Networks*, California Public Service Commission, Docket No. R. 93-04-003 (March 7, 1997) ("California Deposition"), pp. 265-267. The model fails to include such costs in the distribution plant.

[19] California Deposition, p. 403. In that deposition, Dr. Mercer indicated that the $3 default value in Release 2 was based on ARMIS data. Without minimal justification, Releases 3.1 and 4.0 have reduced the default NID expense to $1 per line.

[20] Figure 8 on page 33 of the Model Documentation shows a horizontal cable running along the central axis of a CBG. The cable and structure costs for this cable were incorrectly excluded from Release 3.1.

its correction would increase costs. Such an impression would be highly misleading. In fact, Hatfield Model supporters initially vehemently denied that the connecting cable was missing.[21] Over two months later, Dr. Mercer finally admitted that the cable was missing, but not needed.[22] Now, the error has been finally corrected in Release 4.0. With regard to Dr. Mercer's assertion that critical evaluations of the Hatfield model have identified only those errors that increase costs (at 51), I simply note that my April 4, 1997 testimony for Bell Atlantic in Maryland identified seven calculation errors (including missing connecting and subfeeder cables) and correction of two of these errors had the effect of *lowering* costs.

Q. ARE THERE EXAMPLES OF INCORRECT INPUTS IN THE HATFIELD MODEL?

A. Yes. There are a number of such examples. One involves the fact that the Hatfield Model's default inputs assume that an incumbent telephone company will share support structures with other firms.[23] In particular, the model assigns as little as one-fourth of the cost of poles, conduit, and related structures to telephone operations. This assumption is unsupported by past experience and by any reasonable forward-looking analysis. While poles are, in fact, shared with electric utilities, very little sharing of trenches occurs now or is likely to occur in

[21] In an April 10, 1997 *Ex Parte* Presentation to the FCC, AT&T denied that the central connecting cable is missing as follows: "The BCPM model sponsors claim that horizontal connecting cables are left out of the calculation of distribution costs. This is simply incorrect. Cell AI of the 'calculations' worksheet in the distribution module contains a reference to cell AU of the same worksheet, which is the investment in connecting cables." In fact, cell AU calculates the investment of only the vertical connecting cable for one quadrant. One day later, AT&T/MCI witness Don Wood testified that the investment for the central connecting cable was somewhere other than in cell AU: "I can tell you that with talking to the developers of the model the clarification was exactly as I presented it in my surrebuttal and that is that that investment shows up as feeder or as distribution rather than in this particular column that you are searching it out in." Public Service Commission of Maryland, Case No. 8731, Phase II, Transcript page 183.

[22] *Ex parte:* To determine prices Bell Atlantic - Virginia, Inc. is authorized to charge Competitive Local Exchange Carriers in accordance with the Telecommunications Act of 1997 and applicable State law, Case No. PUC970005, Transcript, page 183. The Hatfield Model developers on prior occasions have denied the validity of criticisms of the Hatfield Model only to admit in later proceedings that their prior denials were unfounded. For example, in the Cost of Basic phase of this proceeding, Dr. Mercer testified that Hatfield Model does not assume that telephone facilities shared conduit with electrical facilities. (Tr. 9/18/96, 188-189.) Yet, during the Interconnection Phase of this proceeding, Dr. Mercer admitted that his previous statements regarding sharing were incorrect and that the model did in fact assume that electrical cables were placed in conduit with telephone facilities. (Tr. 1/22/97, 131-136.) Ultimately, Version 3.1 of the model attempted to correct this deficiency.

[23] In describing the Hatfield Model's rationale for sharing at the Washington Workshop (p. 188-89), one Hatfield witness offered the incredible explanation that the Model assumes that its version of scorched node is implicit for *all* utilities. That is, the Hatfield Model assumes that *all* utilities (electric, telephone, cable television, etc.) will rebuild *all* of their infrastructure at the same time, sharing support structures as they do so. This assumption is clearly ludicrous.

the foreseeable future. Changing this input, as per the FCC Staff's recommendation,[24] so that BA-NJ assumes 66% of the cost of the facilities, causes costs to increase by 8.62%.[25]

Another example is that the default values for the various structure types can differ substantially from current and expected shares. Changing the placement shares for aerial, buried and underground structures to match BA-NJ's current deployment increases Hatfield's basic universal service costs by $1.36 per month.

Q. DOES THE HATFIELD MODEL'S SWITCHING COST FUNCTION UNDERSTATE APPROPRIATE, FORWARD LOOKING SWITCHING INVESTMENT?

A. Yes. While I explain below some of the reasons why the Hatfield Model's switching investment is flawed, it is important to note that in a number of cases I have seen estimates of LEC switching investment that greatly exceed the Hatfield estimates. Recently, my colleague Dr. Gregory Duncan and I reported on a comparison of the Hatfield Model's cost function with one based on data from GTE competitive bids.[26] The data from competitive bids were the lifecycle costs per line for individual switches, and therefore, considered both growth and the higher cost of adding lines to an existing switch. Thus, a switch size/cost per line curve based on the GTE data produces higher costs than the Hatfield curve. In fact, substitution of our function for Hatfield's produces switching investments that are 44 percent higher than those produced by the Hatfield function for BA-NJ.

A recent study by the New York Public Service Commission also examined this issue and concluded that Hatfield switching costs are too low. Using data from recent purchases from

[24] *In the Matter of Federal Joint Board on Universal Service; Forward-Looking Mechanism for High Cost Support Non-Rural LECs*, CC Docket No. 96-45, 97-160, Further Notice of Proposed Rulemaking (rel. July 18,1997) at ¶76-82.

[25] Note that this is a conservative estimate. Due to a coding error, when the sharing fractions increase above 50% for underground plant, the model mistakenly places $1 per density zone for manholes. *See* Hatfield Model Output file, feeder sheet, row 13.

[26] Gregory M. Duncan and Timothy J. Tardiff, "Economic Evaluation of the Hatfield Model, Release 3.1," filed with the Washington Utilities and Transportation Commission, March 28, 1997.

New York Telephone, the PSC found that the switching cost was 54 percent higher than was produced by the Hatfield Model.[27]

Indeed, the switching investment produced by the Hatfield Model does not even match the investment shown in the document used for input prices, which purports to be taken from a Northern Business Information ("NBI") report. The Hatfield Model produces a total investment for local exchange carriers in switching of about $17 billion over 16 years (the Hatfield depreciation life for switching). In contrast, the NBI report projects that LECs will spend $23 billion in only 5 years (1995 - 1999).

Q. WHAT ARE SOME OF THE REASONS WHY THE HATFIELD MODEL UNDERSTATES SWITCHING COSTS?

A. By selectively using heavily discounted prices for new switches and by assuming that a local service provider would instantly install all of the switching capacity it needs to serve all current demand, the Hatfield Model produces costs that are substantially lower than the forward-looking local switching costs that real telephone providers must actually incur to efficiently serve their customers. This approach ignores the fact that frequently the appropriate and efficient course for LECs to follow to serve demand is to buy additional lines for installed switches, not to always buy new switches. The additional lines for installed switches actually cost more, as the NBI switch cost study used by the Hatfield Model describes:

> The add-on market provides significant revenue potential for switch suppliers, particularly as the margins on new switches remain below the margins for the add-on market. A digital line shipped and in place will generate hundreds of dollars in add-on software and hardware revenue during the life of the switch. Suppliers can afford to lose a few dollars on the initial (new) line sale in exchange for the increased revenue in the aftermarket, where prices are less likely to be set by competitive bidding.[28]

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[27] State of New York Public Service Commission, Case 95 - C - 0657, Case 94 - C - 0095, Case 91 - 1174, April 1, 1997, p. 85.

[28] Northern Business Information, *US Central Office Equipment Market - 1994*, McGraw-Hill. In the 1995 version of this report, the Hatfield Model's source for switch prices, add-on prices are over 50 percent higher than new installations.

Also, the Hatfield Model's approach to determining switch costs also suffers from a mismatch between the data sources it employs: the model matches a 1995 forecasted price with an average embedded switch size. This approach assumes that the average *installed* switch is of the same size as the average *new* switch, an assumption that is not necessarily valid.[29] In particular, new switches appear to be larger than installed switches. Therefore, the Hatfield Model incorrectly assigns the lower cost of a larger switch to smaller line size and as a result further underestimates switching investment.[30]

Q. ARE THERE ANY OTHER PROBLEMS WITH THE HATFIELD MODEL'S SWITCH PRICE INPUTS?

A. The input price for trunk ports ($100 per port) is only a fraction of the $305 price listed for ports in the very table in the Northern Business Information report used to support the per line price inputs.[31] Thus, the Hatfield Model appears to be highly selective in how it uses information from its source documents.

Q. HOW DOES THE HATFIELD MODEL PRODUCE SEPARATE COSTS FOR END-OFFICE PORTS AND USAGE WHEN ONLY PER-LINE PRICE INPUTS ARE USED?

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[29] The model creators developed a relationship between switching cost per line and the size of the switch by piecing together information from various sources to create four line size/cost per line data points. For the three lower points, line size is taken from 1995 ARMIS data and costs per line are from the Northern Business Information report. (Information on the largest switch size is based on a conversation with a unidentified switch vendor.) The model's creators then fitted a logarithmic curve to these data points using least-square regression. To reflect the different growth rates in average line size per switch for small and large ILECs, the model uses two different intercept terms, namely one at $242.73 for large ILECs and one at $416.11 for small ILECs.

[30] ARMIS data contained in the *Model Documentation* show the average switch size increasing between 1993 and 1995, which, in turn suggests new installations are larger than the average for the installed base. In fact, operating under the erroneous belief that the average installed switch size was declining, Dr. Mercer recently stated: "A number of parties that have commented on the HM claim that the average switch size is decreasing. To the extent that this is true, and it can be seen in the ARMIS data, the use of 1995 average line size is the denominator of the calculation of cost per line would decrease, not increase, the cost per line." (Reply Declaration of Dr. Robert Mercer, on behalf of AT&T and MCI, before the California Public Utilities Commission, R.93-04-003, I.93-04-002, April 16, 1997, p. 9). Dr. Mercer's basic point here is that when the line size associated with a particular cost per line is higher than the correct value, the investment curve overestimates investment. The converse is that associating a line size that is too low (as the Hatfield Model does) would cause costs to be underestimated. A further problem with the Hatfield curve is its use of average prices and average switch sizes to develop a curve to be applied to *individual* switches. Because the Hatfield curve is nonlinear, its use of averages also produces an underestimate of switching investment.

[31] In addition, a later version of the AT&T capacity cost study that is the source for the port cost shows a *higher* cost.

A. The model assigns exactly 30 percent of end office switching costs to ports and the remaining 70 percent to usage. The resulting costs are then divided by external estimates of the number of lines and minutes served by end offices in a service territory. Dr. Mercer's testimony provides no justification for this arbitrary assignment of end office costs to ports and usage. Such an allocation is clearly inconsistent with the principle of cost-causation and will produce biased estimates (on top of the bias introduced by the Model inputs themselves) when the relative contribution of traffic sensitive costs varies from the input value of 70 percent.

C. The Hatfield Model Does Not Properly Account for Operating Expenses and Common Overhead Costs

Q. PLEASE ASSESS THE HATFIELD MODEL'S TREATMENT OF OPERATING EXPENSES.

A. The Hatfield Model generally develops expense estimates based upon ratios of *booked* expenses to investment. While the use of such annual factors can be appropriate if (1) proper forward-looking adjustments are made, and/or (2) they are applied reasonably consistently with how they were developed, the approach can lead to mistakes if such care is not exercised. That is, operating expense ratios based on historical investment can be a poor approximation to the forward-looking relationship in certain circumstances. Consider, for example, an expense whose costs are unrelated to the underlying technology. As capital equipment becomes more (or less) productive, the expense to capital ratio changes, even though the absolute level of unit expenses does not.

The central office switching example discussed earlier illustrates the potential pitfalls of using annual factors. By employing the unrealistic assumption that a LEC can buy all switching at the initial, heavily discounted prices, the model assumes that annual cost (which I understand includes the generic upgrades) would be lower as well. In fact, the NBI report that the model relies on to develop the switching cost model suggests that such an additional cost may increase when switch vendors discount the prices of initial, but not additional, lines. On the other hand, had a properly developed factor been used with a reasonable estimate of forward-looking investment, the estimated maintenance expense based on the level of investment would be reasonable.

The factor approach also suffers from the general problem that any decrease in an investment will cause an automatic, proportionate decrease in on-going expenses. For example, if one LEC, for whatever reason, obtained a higher discount on purchasing its equipment, the model implies that it would enjoy lower out-of-pocket expenses in the future -- an implication that defies common sense. Just because someone may buy a new car at a discount does not mean the other expenses associated with the car in the future will be less.

Finally, the assumptions that (1) switching and circuit equipment historical factors can be reduced to the level indicated by another company's cost study and (2) that BA-NJ's forward-looking network operations expenses can be well approximated by applying a factor of 50 percent to its current booked expenses are arbitrary and unjustified.[32] It appears that the Hatfield Model has assumed that under forward-looking operations, both BA-NJ's investment costs and expenses would be lower. If, in contrast, competition and loss of scale economies cause certain expenses to *rise*, it is not at all clear that simply applying a factor of 50 percent to current booked expenses would adequately represent BA-NJ's forward-looking expenses. The effect of correcting these three adjustments to the historical factors increases the Hatfield Model's cost of basic universal service by $1.68.

Q. HAVE YOU IDENTIFIED ANY OTHER PROBLEMS WITH THE HATFIELD MODEL'S USE OF HISTORICAL FACTORS?

[32] In fact, the Hatfield Model's reduction of the historical factor by 50 percent is a clear example of its selective use of evidence to artificially reduce the cost of network elements. The Hatfield Model proponents initially rationalized this adjustment by referring to evidence presented by Richard Scholl in California. Examination of the source document reveals that Mr. Scholl compared Hatfield Model results to his results with respect to 12 cost categories. Network operations was the *only* common category where the Hatfield Model produced a higher cost. Significantly, no adjustments have been made to other historical factors where the Hatfield Model costs were lower than Mr. Scholl's. Further, Hatfield experts have testified that their forward-looking reduction is a *long run* outcome (California Deposition, p. 156). Because the model implicitly estimates levelized values of annual expenses over a forward-looking interval, the fact that these expenses will be higher in the near future than the long run implies that the long run factor reduces costs too much.

A. Yes. The model may incorrectly apply the historical factors for underground cable and buried cable when calculating loop distribution costs. The ARMIS data produces factors for buried wire and underground wire that are based on the wire investment. In contrast, the Hatfield Model contains separate wire investment and installation categories. No rationale for this difference in categories is given; indeed, to the extent that installation costs are capitalized, such treatment seems to be inconsistent with the underlying ARMIS data and would understate wire maintenance expenses in the process.

Q. HOW DOES THE HATFIELD MODEL ACCOUNT FOR COMMON OVERHEAD COSTS?

A. The Hatfield Model [Mercer Testimony at 55-59] includes a 10.4 percent "variable support factor" as a way of including common or overhead costs. In testimony in other jurisdictions, AT&T has claimed to have "discovered" a strong statistical relationship between an incumbent LEC's overhead costs and its direct costs (as measured by total operating expenses less corporate operating expenses). Not being in possession of *forward-looking* overhead cost data specific to BA-NJ, AT&T has chosen to represent that cost by the 10.4 percent scale-up variable support factor. AT&T claims that the 10.4 percent figure is derived from the relationship of its own overhead costs to its direct costs.[33] It is not at all clear why a LEC's cost structure should correspond to a reasonable degree of approximation to the cost structure of a pure inter-exchange carrier. Indeed, the fact that the ILECs' networks have acknowledged scope economies in the provision of their myriad of products and services (including unbundled elements) strongly suggests higher common costs than exhibited by less capital-intensive, more specialized firms, such as AT&T was in 1994.

Q. IS THE HATFIELD MODEL SELECTIVE IN ITS USE OF AT&T INFORMATION?

A. Yes. It is very selective. For example, although it uses AT&T's common overhead factor, based on the assertion that this factor reflects the effects of competition, it ignores the fact that AT&T's depreciation rate is much higher than the default rates used in the Hatfield Model. Similarly, for all three expense factors that are reduced from their current values (digital

[33] See Hatfield Model Release 4.0 Inputs Portfolio, Hatfield Associates, August 1, 1997, page 109.

switch, circuit equipment, and network operations), AT&T had corresponding factors that range from 41 percent to 200 percent higher than the factors employed in the Hatfield Model.

D. The Hatfield Model Appears to be Results-Driven and Major Components Are Insufficiently Documented

Q. WHY DO YOU SAY THAT THE HATFIELD MODEL IS RESULTS-DRIVEN?

A. My earlier discussion of the differences between the recent versions of the model has revealed a pattern of when the model developers finally respond to problems that significantly understate costs, certain inputs have been changed to neutralize the impact of the change to the assumption that had understated costs. Thus, when the widely criticized representation of distribution facilities in Version 2.2 was changed in a way that more than doubles route feet (and associated support structure), the inputs recommended by the Hatfield subject matter experts changed in a way that reduced average unit structure costs more than three-fold. On a more modest scale, the model developers have offset the additional costs of formerly excluded distribution and feeder cables by lowering the default input costs for larger cables.

Q. ARE THERE OTHER EXAMPLES THAT ILLUSTRATE HOW CERTAIN COSTS HAVE BEEN LOWERED WHEN THE MODEL WAS CORRECTED TO INCLUDE FORMERLY EXCLUDED COSTS?

A. Yes. Version 3.1, which was originally released at the end of February, was updated in mid-April to correct for a number of errors, including the exclusion of certain amounts of distribution "road cable." The "corrections" also contained a new, undocumented factor that has the effect of reducing backbone cable investment by 50 percent in most cases. No justification for this factor was given and, in fact, neither its existence or a justification is included in the documentation for Release 4.0.[34]

Q. HAVE YOU REVIEWED HOW THE TAPERING OF THE BACKBONE CABLE IS HANDLED?

[34] The New Mexico Public Service Commission recently ruled that this tapering factor improperly reduced costs.

A. Yes. What the model does is simply reduce the backbone cable investment by 50 percent when the number of branch cables exceeds two (which is the case in the large majority of cases in New Jersey). The model documentation describes the backbone cable as a continuation of the connecting cable (at 33) and Figure 8 depicts that cable as having constant size and not tapering. Suppressing the arbitrary tapering reduction increases loop costs by 3.2 percent.

Q. DR. MERCER [AT 12] ALSO CLAIMS THAT THE HATFIELD MODEL, INCLUDING RELEASE 4.0, IS THOROUGHLY DOCUMENTED AND RELIES ON PUBLICLY AVAILABLE DATA AND MODIFIABLE INPUTS, THUS INCREASING THE LEVEL OF REVIEW. IS THIS TRUE?

A. No. While some documentation accompanies Dr. Mercer's testimony, it is not sufficient for the purpose of explaining and understanding the inner workings of the model. Although the limited documentation that is provided with the model describes the various modules involved in the model and the types of user-modifiable inputs built into those modules, the numerous formulas used in the model (programmed in Excel and Visual Basic) are often difficult to follow or comprehend and no supporting material is provided to explain them. Moreover, the contents of the various worksheet modules are only vaguely explained, if at all. This lack of a full explanation of the model's workings means that "reverse engineering" the model through a laborious study of the large number of formulas is the only way a thorough understanding can be obtained.[35] Tellingly, even the changes in the model between version 2.2.2 and Release 3.1 have been described by AT&T and MCI as requiring "hundreds of man-hours of work over several weeks to document, . . ."[36] Similarly, for example, changes to the distribution model

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[35] An example of the difficulty inherent in checking formulas is given by the following formula for the cost of buried placement.

=IF($BO2=1,0,($T2/IF(local_RT=1,2,1)+$U2*$V2+AF2-IF(P2=1,0.5*MIN((SQRT(1-fraction_empty)*0.25*cbg_side-0.5*T2),AG2),0)+IF(local_RT=1,0,AV2+2*AW2/clustrs))*clustrs*VLOOKUP('CBG input data'!$K2,density_inputs,5)*VLOOKUP('CBG input data'!$K2,density_inputs,7)*(rock_mult+diff_sfc-1)*(0.875+0.125*labor_adj))

This (and similar) equations are complicated and difficult to audit for a number of reasons: its sheer length, the multiple logical operations (*e.g.*, nested logic) involved, and the fact that certain numerical values are hard-coded into the formula. For example, 0.875 and 0.125 appear in the last line.

[36] Response to Bell Atlantic-Maryland's Motion to Compel and Cross Motion to Compel Responses from BA-MD,

(continued...)

between Releases 3.1 and 4.0 have increased the number of columns in the "Calculations" Sheet from 66 to 97.

As for its so-called publicly available data, the Hatfield Model relies on a myriad of sources that are not connected in any logical way and which often are not truly "publicly available" in any meaningful sense with respect to verifying the accuracy of the inputs. For example, in developing its inputs, the model developers have combined data from a 1993 New Hampshire incremental cost study, a 1980 Bellcore traffic study, testimony in a California proceeding, an AT&T Capacity Cost study, the "expert" judgments of outside plant engineers, and (more cryptically) "common industry knowledge." The minimal documentation provided with the model offers scant justification for how and why these various sources are mixed and matched for use in the model, and offers no explanation whatsoever as to how or on what basis the model designers (or Dr. Mercer) have concluded data from such diverse sources is relevant to the forward looking costs of providing service in New Jersey. It is hard to dispel the suspicion that the Hatfield Model's choice of inputs leads to results that the model's sponsors would find most acceptable.

III. CONCLUSIONS

Q. PLEASE SUMMARIZE YOUR ASSESSMENT OF THE HATFIELD MODEL.

A. Numerous sources of bias are built into the Hatfield Model assumptions and input structure. These sources of bias result in systematic underestimation of the forward looking costs of an actual efficient provider of service in New Jersey.

The fundamental problem with basing the costs for basic exchange service on cost estimates that are too low, such as those produced by the Hatfield Model, is that efficient local exchange competition will be stopped in its tracks as a result. Artificially low prices (or low

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Case No. 8731 - II, March 20, 1997, at p. 2.

universal service support levels) will inhibit new entrants and the incumbent LECs will not have proper incentives to improve their networks.

Q. SHOULD THE HATFIELD MODEL BE USED TO DETERMINE THE COSTS TO PROVIDE LOCAL EXCHANGE SERVICE FOR THE PURPOSE OF ESTABLISHING A UNIVERSAL SERVICE FUND?

A. No. The model (1) does not represent the circumstances of an actual forward looking network, (2) does not have a realistic view of how real-world firms operate and grow, (3) ignores the potential impacts of competition, and (4) produces misleading and downward-biased estimates of the forward-looking costs of basic service. For these reasons, the Board should not rely upon the Hatfield Model to determine the costs for local exchange service in connection with the development of a Universal Service fund.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

<u>CERTIFICATE OF SERVICE</u>

I hereby certify that on this 27th day of October, 1997, a copy of the foregoing "Reply Comments of Bell Atlantic On Inputs, Expenses, and Other Issues" was served by first class U.S. mail, postage prepaid, on the parties listed on the attached service list.

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